R E M A R K S

The application has been amended so as to place it in condition for allowance at the time of the next Official Action.

Claims 1-17, 21 and 23-33 are pending. Claims 1, 21, and 32 are independent. Claim 22 is being cancelled.

The Official Action objected to claims 22-31 due to an informality.

The Official Action rejected claim 21 under §112, second paragraph, as being indefinite.

Claims 21-31 have been amended responsive to the stated bases of rejection. Withdrawal of the objection and rejection are solicited.

The Official Action rejected claims 1-12, 14, 16, and 17, 21, 32, and 33 under §102(e) as anticipated by DILL et al. 5,898,548.

The Official Action rejected claims 13 and 15 under §103(a) as obvious over DILL et al. '548.

The Official Action rejected the remaining claims under §103 as obvious; that is, claims 22-31 over DILL et al. '548 in view of KROUNBI et al 5,018,037.

Note first that applicants recite inclined end walls covered by an non-magnetic insulation film of tapering thickness. The non-magnetic insulation film in turn being contacted by a magnet layer having a top portion of tapering thickness.

Applicants have carefully studied the devices disclosed DILL et al. and do not find an anticipating device, teachings or suggestions of the recited device. Accordingly, the anticipation rejections and the obviousness rejections are not believed viable.

The Official Action offers element 150 for the bias layer recitation. However, note that element 150, although being a biasing layer, does not meet the complete pending recitation.

In view of the above differences noted between the recited invention and the applied reference, reconsideration and allowance of the independent claims as well as the claims depending therefrom are respectfully requested.

As previously reviewed, the present invention provides a novel and non-obvious structure that enables one to apply a bias magnetic field to the TMR element and accordingly, enables one to obtain a high resolution, a high track density, and a reduced width of the track as is described in the specification, page 10, lines 10-12.

In the presently recited invention, the magneto-resistance effect head includes the center region having inclined end surfaces in the width direction. By using the inclined surfaces, it is possible to easily form an accurate configuration of insulating the side surfaces of the TMR layered film and effectively apply a bias magnetic field. That is, by using the inclined surfaces and tapering films,

the insulation film formed to cover the inclined surfaces need not have a large thickness for sufficiently insulating the TMR layered film and the permanent magnet layer.

Furthermore, since the insulation layer has a small thickness, the permanent magnet layer can be formed at an appropriate position on the insulation film with a high accuracy. The permanent magnet layer is used to apply a bias magnetic field to the TMR layered film. When this permanent magnet layer is arranged at an appropriate position with respect to the position of the TMR layered film, it is possible to effectively apply a bias magnetic field to the TMR layered film. Accordingly, even if the distance between the upper and the lower shield becomes small for a high linear density, and even if the track width, i.e., the patterning width of the TMR layered film becomes small for a high track density, the permanent magnet layer can be positioned with a high accuracy.

Moreover, as is clear from Fig. 8 and Fig. 9 and specification, page 23, line 24 to page 24, line 20, and page 35, line 26 to page 36, line 16, in the present invention, after the insulation layer is formed, the permanent magnet layer is formed directly on the insulation layer 107, which enables an accurate positioning of the permanent magnet layer.

The prior art does not disclose a specific method for forming the bias ferromagnetic layer (equivalent to the

permanent magnet layer in the present invention), and accordingly does not suggest the resulting (recited) structure.

For these further reasons, the present invention, as recited by the present pending claims, is believed to be patentable.

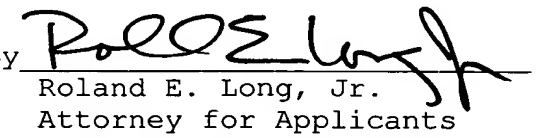
Accordingly, allowance of all the pending claims is respectfully requested.

From the above, applicants believe that the present application is in condition for allowance and an early indication of the same is respectfully requested.

If the Examiner has any questions or requires clarification, the Examiner may contact the undersigned attorney so that this application may continue to be expeditiously advanced.

Respectfully submitted,

YOUNG & THOMPSON

By 

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

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IN THE CLAIMS

--1. (amended) A magneto-resistance effect type composite head comprising:

a first magnetic shield and a second magnetic shield successively layered on a slider;

a reproduction head including a magneto-resistance effect element (hereinafter, referred to as an MR element) arranged between and contacting said first and said second magnetic shields; and

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a recording head arranged adjacent to said reproduction head so as to use said second magnetic shield as a first magnetic pole film and having a second magnetic pole film opposing to said first magnetic pole via a magnetic gap;

said MR element comprising:

a center region including a ferromagnetic tunnel junction magneto-resistance effect film (hereinafter, referred to as a TMR film) having: a first ferromagnetic layer and a second ferromagnetic layer for generating a magneto-resistance effect using said first and said second magnetic shields as electrodes so that a current flows in an almost vertical direction between said first and said second magnetic shields; and a tunnel barrier layer provided between said first and said second ferromagnetic layer; and

an end region arranged on each of two end surfaces of said MR element which run from the first and second magnetic shields, said end regions extending from said first magnetic shield to said second magnetic shield to sandwich said center region from both sides for applying a bias magnetic field to said center region

wherein the center region has a base directly contacting the first magnetic shield and a top directly contacting the second magnetic shield, the base having a first length and the top having a second, smaller length so

that, as viewed in cross section, the center region decreasingly tapers from the base to the top with inclined end walls,

the inclined end walls, from the base to the top, directly contacted by and covered by a non-magnetic insulation film, a thickness of the insulation film being greater at the base than at the top of the center region,

said non-magnetic insulation film directly contacted by a permanent magnet layer for applying the bias magnetic field to said center region, the permanent magnet layer extending from the base to the top with a decreasing cross-section towards the top.--

--21. A magneto-resistance effect type composite head comprising:

a first magnetic shield serving as a first electrode and running in a first planar direction;

a reproduction head having a perimeter defined by upper and lower surface together with end surfaces, the lower surface contacting a center portion of an upper surface of said first magnetic shield;

a first non-magnetic insulation contacting the upper surface of said first magnetic shield and the end surfaces of said reproduction head;

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a second magnetic shield serving as a second electrode running in the first planar direction and contacting the upper surface of said reproduction head;

said reproduction head having a ferromagnetic tunnel junction magneto-resistance effect film with a tunnel barrier layer intermediate first and second ferromagnetic layers for generating a magneto-resistance effect using said first and said second magnetic shields as electrodes so that a current flows in a vertical direction between said first and said second magnetic shields;

a recording head arranged adjacent to said reproduction head so as to use said second magnetic shield as a first magnetic pole film and having a second magnetic pole film opposing to said first magnetic pole [layer] film via a magnetic gap; and

a first end region extending from said first magnetic shield to said second magnetic shield and contacting a first of the end surfaces of said reproduction head and second end region extending from said first magnetic shield to said second magnetic shield and contacting a second of the end surfaces of said reproduction head, said first and second end regions for applying a bias magnetic field to said reproduction head,

wherein the reproduction head has a base contacting the first magnetic shield and a top contacting the second magnetic shield, the base having a first length and the top having a second, smaller length so that, as viewed in cross section, the reproduction head decreasingly tapers from the base to the top with inclined end walls,

the inclined end walls, from the base to the top, directly contacted by and covered by the first non-magnetic insulation film, a thickness of the insulation film being greater at the base than at the top of the center region,

the non-magnetic insulation film directly contacted by a permanent magnet layer for applying the bias magnetic field to said reproduction head, the permanent magnet layer extending from the base to the top with a decreasing cross-section towards the top.--

Cancel claim 22.

Amend claim 23 as follows:

--23. (amended) The [A] magneto-resistance effect element as claimed in claim [22] 1, wherein a thickness of the insulation film is smaller than a thickness of the center region.--

--24. The [A] magneto-resistance effect element as claimed in claim [22] 1, further comprising:

a permanent magnet layer, providing the TMR film with a bias field,

the permanent magnetic layer being electrically separated from the tunnel barrier layer of the TMR film by the insulation film.

--25. The [A] magneto-resistance effect element as claimed in claim [22] 1, wherein the TMR film comprises an undercoat layer, the first ferromagnetic layer, the tunnel barrier layer, the second ferromagnetic layer, and an anti-ferromagnetic layer successively arranged in this order.

--26. The [A] magneto-resistance effect element as claimed in claim [22] 1, wherein the TMR film comprises an undercoat layer, an antiferromagnetic layer, the first ferromagnetic layer, the tunnel barrier layer, the second ferromagnetic layer, and a non-magnetic conductive layer successively arranged in this order.

--27. The [A] magneto-resistance effect element as claimed in claim 25, wherein said antiferromagnetic film is made from an alloy comprising as a main content Mn-X, wherein X represents at least one element selected from a group

consisting of Cr, Fe, Co, Ni, Tc, Ru, Rh, Pd, Re, Os, Ir, and Pt.

--28. The [A] magneto-resistance effect element as claimed in claim 26, wherein said antiferromagnetic film is made from an alloy comprising as a main content Mn-X, wherein X represents at least one element selected from a group consisting of Cr, Fe, Co, Ni, Tc, Ru, Rh, Pd, Re, Os, Ir, and Pt.

--29. The [A] magneto-resistance effect element as claimed in claim 25, wherein said undercoat layer comprises as a main content at least one element selected from a group consisting of Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Hf, Ta, W, Re, Os, Ir, Pt, and Si.

--30. The [A] magneto-resistance effect element as claimed in claim 26, wherein said undercoat layer comprises as a main content at least one element selected from a group consisting of Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Hf, Ta, W, Re, Os, Ir, Pt, and Si.

--31. The [A] magneto-resistance effect element as claimed in claim [22] 1, wherein said first and said second

ferromagnetic layers are formed from Fe, Co, or Ni, or an alloy containing Fe, Co, or Ni.

Amend claim 32 as follows:

--32. (amended) A magneto-resistance effect head comprising:

a pair of magnetic shields arranged facing to each other as electrodes;

a first magnetic shield serving as a first electrode and running in a first planar direction;

a reproduction head having a perimeter defined by upper and lower surface together with end surfaces, the lower surface contacting a center portion of an upper surface of said first magnetic shield;

a first non-magnetic insulation contacting the upper surface of said first magnetic shield and the end surfaces of said reproduction head;

a second magnetic shield serving as a second electrode running in the first planar direction and contacting the upper surface of said reproduction head;

said reproduction head having a center region comprising a ferromagnetic tunnel junction magneto-resistance effect film with a tunnel barrier layer intermediate first and second ferromagnetic layers for generating a magneto-resistance effect using said first and said second magnetic

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shields as electrodes so that a current flows in a vertical direction between said first and said second magnetic shields;

a recording head arranged adjacent to said reproduction head so as to use said second magnetic shield as a first magnetic pole film and having a second magnetic pole film opposing to said first magnetic pole via a magnetic gap; and

a first end region extending from said first magnetic shield to said second magnetic shield and contacting a first of the end surfaces of said reproduction head and second end region extending from said first magnetic shield to said second magnetic shield and contacting a second of the end surfaces of said reproduction head, said first and second end regions for applying a bias magnetic field to said reproduction head;

the center region being intermediate the pair of magnetic shields so that a magneto-resistance effect is generated by a current flowing almost in a vertical direction to the magnetic shields,

wherein the center region has a base contacting the first magnetic shield and a top contacting the second magnetic shield, the base having a first length and the top having a second, smaller length so that, as viewed in cross

section, the center region decreasingly tapers from the base to the top with inclined end walls,

the inclined end walls, from the base to the top, directly contacted by and covered by the first non-magnetic insulation film, a tapering thickness of the non-magnetic insulation film being greater at the base than at the top of the center region,

the non-magnetic insulation film directly contacted by a permanent magnet layer for applying the bias magnetic field to said reproduction head, the permanent magnet layer extending from the base to the top and with an upper portion having a tapering decreasing cross-section.--